Environmental CLEANUP

Jet Propulsion Laboratory Information Sheet *August 1996*

HAZARDOUS CHEMICALS

TO PROTECT PUBLIC HEALTH, THE GOVERNMENT ESTABLISHES MAXIMUM LEVELS FOR CHEMICALS IN PUBLIC DRINKING WATER

Chemical CONTAMINATION

The worldwide increase in chemical contamination in both surface and ground water has generated much public concern over the health risks associated with human exposure to contaminating substances. While much has been learned about the effects of chemicals on human and environmental health, there are still many uncertainties regarding the long-term effects of low levels of exposure to toxic chemicals. To protect human health, the federal government and the state of California have established standards for maximum levels of various chemicals in public drinking water systems.

Several chemicals have been detected at levels above state and federal drinking water standards in the ground water beneath and adjacent to JPL. These so-called "chemicals of concern" fall into two broad categories: volatile organic compounds (VOCs), which are carbon-containing substances usually manufactured by humans; and inorganic metals, which occur naturally in the environment at very low concentrations, but may be concentrated for human use. This information sheet describes some of the general characteristics of these chemicals and presents specific information on the chemicals of greatest concern to JPL's Superfund Project environmental cleanup efforts.

Volatile Organic COMPOUNDS

Six VOCs of primary concern (see the table on the next page) have been detected in the ground water beneath and adjacent to JPL. All six of these chemicals have several things in common. Compositionally, they are made of varying amounts of hydrogen (H), carbon (C), and chlorine (Cl). All are "volatile," that is, they evaporate easily at room temperature (as compared to water).

In addition, these VOCs are all solvents that are, or were, widely used commercially; all have been associated with potentially adverse health effects.

VOC ENVIRONMENT

Years ago, it was common practice for industry to dispose of waste liquids using seepage pits or cesspools, which were designed to collect liquid waste products and allow them to percolate gradually into the subsurface soil. It has since been recognized that this method of disposal is unsuitable for hazardous liquids because these waste products can eventually reach the ground-water system and cause contamination.

Organic compounds such as VOCs are particularly problematic in ground water for several reasons. Once VOCs are in the subsurface, they have limited contact with the air and cannot readily evaporate. Organisms living in the upper part of the soil have the potential to break down organic compounds into other, less-dangerous chemicals. However, deep ground-water aquifers are relatively free of such organisms. Finally, ground water moves relatively slowly as compared to surface water, and the temperature and rates of flow may remain relatively constant over long periods of time.

Fortunately, there are a number of effective ways to treat ground water contaminated with VOCs. Most involve pumping the water out of the ground, treating the water in one or more ways, then either re-injecting the water back into the ground or using it for some productive purpose. Typical treatment strategies include filtering, air or steam stripping, and chemical or biological treatment, among others. These "pump and treat" systems have proven quite successful in many previous ground-water cleanup projects in reducing or eliminating hazardous chemicals or containing the contaminated ground water.

Volatile Organic Compounds: Uses and Effects

COMPOUND	COMMON USES	EXPOSURE EFFECTS	MAXIMUM CONTAMINANT LEVEL *
Carbon Tetrachloride *CTC, CCl_4, Freon 10*	Used in manufacture of refrigerants, foam-blowing agents, and solvents; grain fumigant; as a dry-cleaning fluid, aerosol propellant, and pharmaceutical aid	Carcinogenic; can affect liver, kidneys, and central nervous system	0.5 µg/l
1,2–Dichloroethane *DCA, $C_2H_4Cl_2$, Ethylene dichloride*	By-product in manufacture of vinyl chloride, solvents, paints, coatings, and adhesives	Inhalation hazard: can affect central nervous system; is linked to liver and kidney damage; is a suspected carcinogen	5.0 µg/l
Dichloroethylene *DCE, $C_2H_2Cl_2$, Acetylene dichloride*	Solvent for fats, camphor, etc.; used as an agent to retard fermentation	Can cause eye and respiratory irritation; can cause nausea and vomiting; can affect central nervous system	7.0 µg/l
Tetrachloroethylene *PCE, C_2Cl_4, Perchloroethylene*	Solvent in dry-cleaning systems; used as a rug/upholstery cleaner and a spot, stain, and lipstick remover; used in printing ink; used as a metal degreaser; used as medical treatment for liver flukes and hookworm, tapeworm, and pinworm infections	Associated with central nervous system depression, kidney and liver dysfunction; is a suspected carcinogen	5.0 µg/l
1,1,1–Trichloroethane *TCA, $C_2H_3Cl_3$, Methylchloroform*	Solvent in cleaning metals and for removing adhesives; used in leather-tanning, inks, and shoe polish; used as a drain cleaner	An eye irritant; could lead to cardiotoxicity	200 µg/l
Trichloroethylene *TCE, C_2HCl_3*	Metal degreaser; used in spot removers, rug cleaners, air fresheners, and dry-cleaning fluids; used as an analgesic and inhalation anesthetic; used as a disinfectant to remove oil and tar from wounded animals	Can cause headaches, vomiting, nausea, seizures, paralysis, and blindness; may result in liver and kidney damage	5.0 µg/l

* *Maximum contaminant level allowable by federal or state government standards.*

Heavy METALS

The two metallic contaminants of greatest concern at JPL are mercury (Hg) and chromium (Cr). Both of these metals occur naturally, and can be found at very low levels in the environment even where no contamination by humans has taken place. Both metals are also widely used by people and industry, so there are numerous possible sources for mercury or chromium contamination of ground water and soil.

Mercury

Most people are familiar with mercury — an unusual metal because it remains liquid at room temperature. In fact, mercury does not become a solid until it is cooled to a temperature of 39 degrees Fahrenheit. Because of its particularly unique physical properties, mercury is widely used in many different kinds of applications: in thermometers and barometers; for gold and silver extraction; in fluorescent lamps; electrolysis; dentistry; mirrors; and in pharmaceuticals.

The primary hazard of mercury is in inhaling mercury vapors or dust. Because metallic mercury is slightly volatile at room temperatures, the potential for inhaling mercury vapors is particularly high. Once mercury enters the respiratory tract, it is then easily absorbed into the body. Contact with mercury can cause the corrosion of skin and membranes, nerve dysfunction, kidney damage, tremors, nervousness, personality change, and, in extreme cases, even death. State and federal regulations set the maximum contaminant level (MCL) for mercury in public drinking water at 2 µg/l.

Chromium

Although you may not realize it, most people are probably also familiar with chromium and its various "oxides" (chromium atoms combined with either two or three oxygen atoms). Chromium metal is used in making stainless steel and chrome–metal alloys, and as chrome plating on other metals. Chromium oxide (Cr_2O_3) is used in paint pigments on porcelain, fabric, and bank notes. Chromium trioxide (CrO_3) is used as a topical antiseptic and in chrome plating, batteries, and photography.

Chromium and many chromium compounds (such as CrO_3) are considered extremely toxic, especially if taken internally or applied externally in large doses. Symptoms of chromium exposure include skin irritation or ulceration; respiratory tract damage if vapors are inhaled; and nausea, vomiting, or gastroenteritis if ingested. The MCL for chromium in drinking water is 50 µg/l.

Metal TREATMENT

Treatment strategies for removing inorganic metals from water are substantially different than the treatment for VOCs. In some cases, chemicals that combine with the metals are added to the water being treated. This causes both the metals and the added chemicals to precipitate out of the solution, allowing for them to be safely removed from the water.

Other treatment techniques include ion exchange, in which metal atoms are chemically replaced with other, nonhazardous atoms; reverse osmosis, in which pressure forces water through a semipermeable membrane, leaving the contamination behind; or electrolysis, which actually uses electricity to recover the metal from water.

In any ground-water cleanup project, a thorough understanding of the nature of the contaminants, their concentration, and their distribution in the environment, is critical in the design and implementation of a treatment or cleanup plan. Such knowledge is only gained through detailed, systematic study of the ground-water problem and careful engineering of cleanup solutions.

SUPERFUND INFORMATION

For information on the environmental cleanup effort at JPL, and for ideas on how you can become involved, please contact:

Public Services Office
Jet Propulsion Laboratory,
186-113
4800 Oak Grove Drive
Pasadena, California
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Tel: (818) 354-0112

For copies of other documents related to the Superfund cleanup, check these local public information repositories:

Altadena Public Library
600 E. Mariposa St.
Altadena

La Cañada-Flintridge
Public Library
4545 W. Oakwood Ave.
La Cañada-Flintridge

Pasadena Central Library
280 E. Walnut St.
Pasadena

The following sources of information were used in preparing this Environmental Cleanup information sheet:

More READING

- *The Merck Index*, Merck & Co., New Jersey.
- *The NIOSH Pocket Guide to Hazardous Chemicals*, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1990.
- *Occurrence and Removal of Volatile Organic Chemicals From Drinking Water*, Cooperative Research Report, American Water Works Association Research Foundation, Denver, Colorado, 1983.
- *Safe Drinking Water Act*, Code of Federal Regulations (40 CFR 141).
- *Safe Drinking Water and Toxic Enforcement Act*, California Code of Regulations, Title 22.

The following local contacts represent agencies involved in the Superfund process:

Agency CONTACTS

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THE METALLIC CONTAMINANTS OF GREATEST CONCERN AT JPL ARE MERCURY AND CHROMIUM

National Aeronautics and Space Administration

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